

# VACUUM PROCESS APPARATUS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a vacuum process apparatus of the kind, including at least two stations for treating or handling the workpiece, and a transport device with conveyor means thereon, each for transporting at least one workpiece from station to station.

### 2. Description of the Prior Art

The German specification DE-A-24 54 544 and "Patent Abstracts of Japan", Nov. 28, 1989, vol. 13, no. 532, JP-A2 1-218 627, disclose as an example such a vacuum process apparatus which includes at least two stations, each comprising an opening for an article, the openings each determining an opening area with surface normal  $A_n$  perpendicular to the opening area  $F$  such as illustrated in FIG. 1 for sake of clarity. The said apparatus further includes a transport device which is supported and driven to rotate around a space axis as rotational axis and includes at least one conveyor portion for an article, whereby the conveyor portion is moved consecutively to and from the openings of the stations.

In contrary to the design of the apparatus according to the JP-1-218627, the transport device of which comprising only one conveyor portion for an article and whereat the conveyor portion is rigidly fixed on a rotatable cylinder forming the transport device, the apparatus according to the German patent no. 24 54 544 comprises four conveyor portions for articles. These conveyor portions are additionally movable with respect to the transport device. By means of a driving plunger there is realized for each conveyor portion an individual drive for moving the said conveyor portion of the transport device relative to a respective station.

Thus, according to the apparatus of the German patent no. 24 54 544, the conveyor portion may be positioned at different positions with respect to a respective station, according to the specific requirements of a process performed at the station considered, up to providing for a sealing closure of the said opening by means of the conveyor portion.

Provision of the said driving plungers which are led through the wall of the vacuum recipient has different drawbacks:

a) For every driving plunger there must be provided a dynamic gliding vacuum seal which results in a considerable additional expenditure for the apparatus in view of vacuum technical requirements for such dynamic seals.

b) The said driving plungers are individually associated to respective stations. Thus, if an apparatus or vacuum plant shall be changed by changing the number of process stations mounted thereon and especially shall be changed by raising the number of such process stations provided, the complete apparatus with its vacuum recipient must be changed according to the changing number of vacuum tight mounted driving plungers.

It is a first object of the present invention to remedy these drawbacks and to provide a vacuum process apparatus which comprises a self-comprised transport device which may flexibly be used for a great number of different apparatus configurations with respect to the number of the process stations provided.

The design of vacuum process apparatuses according to the DE-A-24 54 544 which have established themselves on the market has the further drawback that the

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It is thus a further object of the present invention to  
20 remedy this drawback and to provide a vacuum process  
apparatus with a transport device-to station openings-  
relation which allow a significantly improved construc-  
tional freedom for such apparatus.

It is thus a first object of the present invention to provide a vacuum process apparatus of the kind mentioned above which comprises a transport device which may be used flexibly for different apparatus configurations as concerns number of treating or handling stations provided thereon.

A further object of the invention is to provide a vacuum process apparatus for processing at least one workpiece, comprising at least two stations for treating or handling said workpiece, and having each at least one opening for the workpiece; a transport device rotatable around an axis; a drive arrangement for rotating said transport device; at least two conveyor means arranged at said transport device for at least one workpiece each; driving means at said transport device respectively coupled to said conveyor means to individually move said conveyor means relative to said transport device towards and from said openings.

65 It is still an object of the present invention to provide said apparatus with openings defining an opening area each, the normals on said areas being warped with respect to said rotational axis.

It is, nevertheless, a further object to provide said vacuum process chamber wherein the said normals of said areas point in direction of respective generatrix lines of the trajectory cone surface. This leads to a further simplification of the apparatus, in that linear movement of the said conveyor means in direction of

said transport arms will suffice to respectively serve the station openings.

Even in this case it is still possible to stagger the openings of the stations along different great circles of the conical trajectory surface. This is nevertheless not always necessary and may lead to problems in that stations staggered on different great circles and with openings along the same generatrix and thus substantially aligned in generatrix direction may cover each other, making access to the said openings by said conveyor means more difficult.

It is, thus, a further object of the invention to provide a vacuum process apparatus in which the said openings of the stations are located substantially along one single great circle of the trajectory cone surface.

It is still a further object of the present invention to provide a vacuum process apparatus in which the stations communicate by the said openings with the inside of a chamber, said transport device residing within the said chamber. On one hand, by such a design the transport device is protected and further the danger of contamination of the atmosphere prevailing within the stations is decreased because, as mentioned, the openings of the stations communicate with the chamber.

Depending from the desired process or treatment performed within the respective stations, it is a further object to provide the vacuum process apparatus which comprises gas inlet means and pumping means, at least at one of the said stations and of the said chamber.

By providing such gas inlets and pumping means selectively at the said stations and/or the said chamber, one has the freedom to perform with the apparatus different vacuum processes which are allowed or are not allowed to influence each other by atmosphere communication.

It is yet a further object of the invention to provide an apparatus whereon at least one of said conveyor means is coupled to a seal member for sealingly closing the opening of at least one of the said stations. Thereby it becomes possible to sealingly close the respective station which is advantageous if in that station a vacuum process shall be performed which necessitates a clearly defined gaseous atmosphere. The seal member may be formed by a plate-like member of the conveyor means.

Further, the said plate or disk-like member may form one door of a charging or discharging load lock for a workpiece to be charged or discharged with respect to the said chamber or the said plate may be the workpiece support feeding the workpiece through the station opening of a sputtering station whereby the seal member sealing the sputtering station against the chamber wherein the transport device is disposed.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a schematic illustration for explaining the relative position of opening, opening area and of the normal thereon;

FIG. 2 is a sectional view of a presently preferred embodiment of the inventive vacuum process apparatus;

FIG. 3 is an illustration of an apparatus according to FIG. 2 or 4, resp. having a trajectory cone surface with



The basic principle of the apparatus explained with reference to FIGS. 2 to 4 is schematically illustrated in

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While there are shown and described present preferred embodiments of the invention it is to be distinctly